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[Title of the Invention]	Image Reading Apparatus
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[Inventor]	
[Address]	c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo
[Name]	Taira Nishita
[Inventor]	
[Address]	c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo
[Name]	Hiroyuki Kawamoto
[Inventor]	
[Address]	c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo
[Name]	Isao Miyamoto
[Inventor]	
[Address]	c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo
[Name]	Tomoyuki Yoshida
[Inventor]	
[Address]	c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo
[Name]	Satoshi Ohkawa
[Inventor]	
[Address]	c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo
[Name]	Maki Oyama
[Inventor]	
[Address]	c/o Ricoh Company, Ltd.,

3-6, Nakamagome 1-chome, Ota-ku, Tokyo

[Name] Atsushi Togami

[Inventor]

[Address] c/o Ricoh Company, Ltd., 3-6, Nakamagome 1-chome, Ota-ku, Tokyo

[Name] Yasunobu Shirata

[Applicant]

[Id. No.] 000006747

[Address] 3-6, Nakamagome 1-chome, Ota-ku, Tokyo

[Name] Ricoh Company, Ltd.

[Representative] Masamitsu Sakurai

[Agent]

[Id. No.] 100110319

[Patent Attorney]

[Name] Keiji Nemoto

[Application Fee]

[Payment No.] 066394

[Amount of Payment] 21,000 Yen

[List of Attached Documents]

[Name of Document] Specification 1

[Name of Document] Drawing 1

[Name of Document] Abstract 1

[General Power of Attorney No.] 9815947

[Necessity of Proof] Necessary

[Name of Document] Specification

[Title of the Invention] Image Reading Apparatus

[Scope of Claims]

[Claim 1]

An image reading apparatus which may be connected to an electric communication line, characterized by comprising:

a means for performing spatial filter processing for expanding a dynamic range of original data read by the image reading apparatus and having a predetermined dynamic range

and resolution;

a means for converting the resolution of the original data having the expanded dynamic range into higher density;

a means for converting the dynamic range of the original data, having the expanded dynamic range and the resolution converted into higher density, back into the predetermined dynamic range;

a means for converting the resolution of the original data, having the converted dynamic range and the higher density resolution, back into the predetermined resolution; and

a means for transmitting the original data having the resolution converted back into the predetermined resolution.

[Claim 2]

The image reading apparatus according to claim 1, characterized in that the spatial filter processing means calculates a maximum tone value of the original data obtained after the spatial filter processing, based on spatial filter factor set in advance, and expands the dynamic range of the original data to be wider than the value.

[Claim 3]

The image reading apparatus according to claim 1 or 2, characterized in that the means for transmitting the original data having the resolution converted back into the predetermined resolution, transmits the original data after compression.

[Claim 4]

The image reading apparatus according to claim 3, characterized in that the means for transmitting the original data having the resolution converted back into the predetermined resolution, transmits the original data after compression with reversible coding.

[Claim 5]

The image reading apparatus according to any one of claims 1 to 4, characterized by comprising a gamma correction processing means and/or a tone processing means.

[Claim 6]

The image reading apparatus according to claim 5, characterized in that the tone processing means performs processing for converting the original data having the expanded dynamic range and the resolution converted into higher density, into halftone of two levels.

[Claim 7]

The image reading apparatus according to claim 5, characterized in that the tone processing means performs processing for classifying original data having the expanded dynamic range and the resolution converted into the higher density, into maximum and minimum values of the dynamic range depending on a predetermined threshold, and processing for converting the classified original data into halftone of two levels.

[Detailed Description of the Present Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to an image reading apparatus being able to be connected to an electric communication line, and having a means for processing image data by the image reading apparatus itself, and for transmitting the image data to a storage device such as a personal computer connected to an electric communication line.

[0002]

[Background Art]

Conventionally, an image reading apparatus such as scanner and a computer (hereinafter, referred to as a PC) has been connected via an electric communication line such as LAN and the Internet. The image reading apparatus reads

an image according to a direction from the PC, transfers the image data to the PC and performs image processing such as spatial filter processing by image processing software installed in the PC. When the image has been printed by a printing device directly connected to the PC or when the image reading apparatus has a printing device, the image data after image processing is transmitted to the printing device of the image reading apparatus to be printed.

Therefore, when the image reading apparatus is placed distant from the PC, a user has to move to a place where the PC is placed to perform image processing, resulting in inconvenience.

[0003]

On the other hand, conventionally, when an image reading apparatus reads and reproduces a halftone dot image, density unevenness called moire (or moire stripes) occurs in the reproduced image, and the density unevenness is well known to deteriorate the image quality. The occurrence of moire happens because of interference between halftone dot period of original image and sampling period for dissolving pixels during image reading. The moire also occurs because of steep gamma correction processing or a saturation operation by spatial filter processing. Therefore a digital copier for suppressing moire has been disclosed.

[0004]

[Patent reference 1]

Japanese Patent Laid-Open Publication No. Hei5-41793 (Paragraph (0021), (0022), (0023), Fig. 7)

[0005]

The digital copier for controlling moire, disclosed in Patent reference 1, generates image data D'n of a virtual sampling point for arbitral image data Dn by a so-called cubic function interpolation, and a method to synthesize the image

data Dn and D'n. For example, if both the image data Dn and D'n have 400 dpi resolution, the synthesized image is to have 800 dpi resolution. This means the image data Dn and D'n has been read in a double sampling frequency, so there is almost no occurrence of moire in a halftone dot image. However, in this method of generating image data D'n of a virtual sampling point and synthesizing the resulting data and the original image data Dn, the occurrence of moire caused by using saturation operation of spatial filter may not be suppressed. Also, it has not been conducted to further process the image data and transmit the image data to a PC and the like.

[0006]

[Problems to be solved]

The present invention is made taking into account of the situation described above. A first object of the present invention is that an image reading apparatus that reads image data performs image processing of the image data by itself to avoid inconvenience for a user to move to a location of a PC when the image reading apparatus such as scanner is located distant from the PC via an electric communication line such as LAN and the Internet. A second object of the present invention is to avoid occurrence of moire caused by saturation operation of spatial filter processing when the image reading apparatus that read the image data to perform image processing of the image data by itself. A third object of the present invention is to perform image processing to the image data without moire and to transfer the image data to a PC and the like.

[0007]

[Means for solving the problems]

The invention of claim 1 is an image reading apparatus which may be connected to an electric communication line, characterized by including a means for performing spatial

filter processing for expanding a dynamic range of original data which is read by the image reading apparatus and have a predetermined dynamic range and resolution, a means for converting the resolution of the original data having the expanded dynamic range into higher density, a means for converting the dynamic range of the original data, having the expanded dynamic range and the resolution converted into higher density, back into the predetermined dynamic range, a means for converting the resolution of the original data, having the converted dynamic range and the higher density resolution, back into the predetermined resolution, and a means for transmitting the original data having the resolution converted back into the predetermined resolution.

[0008]

The invention of claim 2 is the image reading apparatus according to claim 1, characterized in that the spatial filter processing means calculates a maximum tone value of the original data obtained after the spatial filter processing, based on spatial filter factor set in advance, and expands the dynamic range of the original data to become wider than the value.

[0009]

The invention of claim 3 is the image reading apparatus according to claim 1 or 2, characterized in that the means for transmitting the original data having the resolution converted back into the predetermined resolution, transmits the original data after compression.

[0010]

The invention of claim 4 is the image reading apparatus according to claim 3, characterized in that the means for transmitting the original data having the resolution converted back into the predetermined resolution, transmits the original data after compression with reversible coding.

[0011]

The invention of claim 5 is the image reading apparatus according to any one of claims 1 to 4, characterized by including a gamma correction processing means and/or a tone processing means.

[0012]

The invention of claim 6 is the image reading apparatus according to claim 5, characterized in that the tone processing means performs processing for converting the original data having the expanded dynamic range and the resolution converted into higher density, into halftone of two levels.

[0013]

The invention of claim 7 is the image reading apparatus according to claim 5, characterized in that the tone processing means performs processing for classifying original data having the expanded dynamic range and the resolution converted into the higher density, into two values of the dynamic range, maximum value and minimum value, depending on a predetermined threshold, and processing for converting the classified original data into halftone of two levels.

[0014]

[Description of the Preferred Embodiments]

Next, a scanner apparatus of an embodiment of the present invention is explained referring to figs. Fig. 1 is a diagram showing a scanner apparatus, a printer, and a PC (Personal Computer) according to the embodiment of the invention that are connected on an electric communication line such as a LAN. In the figure, a scanner apparatus 10, a PC 20, and a printer 30 are connected to a LAN 40. The scanner apparatus 10 includes an electrical structure to be described later in Fig. 2 to perform image processing to the image data having been read. For this purpose, the scanner apparatus 10 includes a mechanical

structure to be described later in Fig. 3 and reads an original image.

[0015]

Fig. 2 is an electric block diagram of the scanner apparatus according to this embodiment of the present invention. In the figure, a user interface unit 1 is an interface unit (operation part) of a liquid crystal touch panel system used by a user to instruct the scanner apparatus to perform various operations. A CPU 2 is a central processing unit that issues control instructions to each unit to be described later such that the units operate as instructed by the user interface unit 1. A ROM 3 is a storage device that stores a software program with which the CPU 2 controls the each unit according to an operation instruction received from the user interface unit 1. A scanner unit 4 is an optical original reading system. Note that a CCD of a reduction optical system or a contact CCD of a non-magnification optical system is used for the optical original reading system.

[0016]

A memory control unit 5 is a control unit which stores the image data transmitted from the scanner unit 4 in the RAM 6 serving as a temporary storage and performs arbitration for image processing and speed adjustment of the next-process, an image processing unit 7 is a processing unit that applies spatial filter processing and moire control processing to image data to be described in detail in Figs. 5 to 10, a RAM 8 is a device that temporarily stores the image data for each line for these pieces of processing, and an external transfer unit 9 is a transfer unit that transfers the image data subjected to the image processing in the image processing unit 7 to the PC 20. In addition, a storage unit 21 is a storage unit such as the PC 20.

[0017]

Figs. 3 are explanatory diagram for explaining main sections of a scanner unit according to this embodiment. Figs. 3 (A), (B) and (C) are schematic side sectional diagram, and Fig. 3 (D) is a diagram showing a scanning direction with respect to an original.

As shown in Figs. 3, the scanner unit 4 has a traveling body 41

that is mounted with an element for actually reading image data, an original conveying path 42 for an original to pass through a reading position 45, and a white reference plate 43 that serves as a reference for a white level of image data beside the reading position 45. The white reference plate 43 serves as a reference for a white level for performing shading correction for a reading optical system. The traveling body 41 includes a lamp 41a which irradiates light in a direction of the reading position 45 and a light-receiving element 41b such as a CCD which receives reflected light of the light. The original conveying path 42 is formed of transparent glass (contact glass) 44 such that an original may be read from a lower side of the conveying path only in the reading position.

[0018]

Fig. 3 (A) is a situation when the reading optical system is in an idle state. When an instruction to read an original is transmitted from the CPU 2 of Fig. 2 in this situation, the traveling body 41 moves to a position of the white reference plate 43 as shown in Fig. 3 (B), and the lamp 41 a irradiates light on the white reference plate 43, and then the light-receiving element 41b receives light reflected from the white reflection plate 43. A received optical signal is converted into an analog electric signal by a not-shown CCD and further subjected to A/D conversion, and a reading operation for generating a digital electric signal is performed. Then, the reading of the white reference plate 43 for reading concentration of the entire white reference plate is performed, and several lines of the concentration data is set as white reference data, and the setting ends. Next, when reading of an original is started, the traveling body 41 moves to below the original reading position 45 as shown in Fig. 3 (C) and stops. When an original 46 passes, above the traveling body 41 through the original conveying path 42 at a constant speed, the lamp 41a irradiates light to the original 46, and light reflected from the original 46 is received by the light-receiving element 41b, like the reading of the white reference plate. When it is assumed that a corner of a leading edge

of the original 46 (Fig. 3 (D)) is an original reference point, the original 46 is read line by line in a main scanning direction in Fig. 3 (D), reading in a sub-scanning direction is performed according to movement of the original 46, and the entire original 46 is read, for example, at a gradient of 600 DPI and eight bits (0 to 255 tones).

[0019]

Note that the white reference data and the image data, which are read as described above, are used as an example, for performing shading correction processing as described below and performing correction of a reading white level of the reading optical system.

Fig. 4 is a diagram explaining white reference data and correction data that is generated based on this data. In the figure, the white reference data is subjected to average processing for each pixel to be generated as white level correction data for one main scanning line. As shown in Fig. 4, white reference data for lines of an arbitrary number N is subjected to simple average processing for each pixel in a main scanning direction to be generated as shading correction data. The image data is subjected to shading correction processing per each line based on the shading correction data for one line generated in this way. In other words, when pixels of the light-receiving element 41b are numbers 0, 1, ..., n from a top pixel, and it is assumed that image data before correction to be processed is Xk, image data after correction is Xk', and shading correction data for the pixels is Sk, the image data is subjected to shading correction processing according to $Xk'=(Xk/Sk)x255$ ($k=0, 1, \ldots, n$). However, in the case of $Sk=0$, it is assumed that $Xk'=255$.

[0020]

Operations of the scanner apparatus is explained with reference to Figs 1, 2, 3, and 4. While the scanner apparatus 10 is in an idle state waiting for an operation instruction, when an operation instruction is inputted by a user from the user interface unit (operation unit) 1, an operation instruction signal is transmitted to the CPU 2. The CPU 2 executes a program stored in the ROM 3 through

a CPU bus and transmits a control signal to the scanner unit 4, the memory control unit 5, the image processing unit 7, and the external transfer unit 9. The scanner unit 4, which has received the control signal from the CPU 2, reads an original in the form explained in Figs. 3 and 4 and transfers original data to the memory control unit 5. The memory control unit 5 stores in the transferred image data the RAM 6 such as a SDRAM once, reads out the stored image data while adjusting a transfer speed of data to the next image processing unit 7, and transfers the image data to the image processing unit 7. The image processing unit 7 performs image processing such as spatial filter processing and moire control processing as described later with reference to Figs. 5 to 8 and transfers the image data subjected to the image processing to the external transfer unit 9. The external transfer unit 9 transfers the transferred image data after the image processing to the storage unit 21 such as the PC 20, which is connected to an electric communication line such as a LAN, by using software using a processor or the like or by using dedicated hardware such as an ASIC.

[0021]

Next, the image processing in the image processing unit 7 is explained in detail with reference to Figs. 5 to 8.

Fig. 5 is a block diagram for explaining main sections of a scanner apparatus. As shown in this figure, a spatial filter processing unit 7a of the image processing unit 7 includes spatial filters in a table format made of, for example, 3x3 masks for performing processing such as softening processing, sharpening processing, and emboss processing for an image. When a user selects, for example, the softening processing from the operation unit 1 and instructs transfer of image processing data to the external storeage unit 21, the CPU 1 reads out the spatial filter for the softening processing from the table, applies arithmetic processing for softening to each pixel, and calculates a predetermined number of tones.

In this case, depending upon a method of setting a filter factor,

a dynamic range (n bits) of image data after the spatial filter processing may be larger than a dynamic range (m bit) of inputted image data (n>m). When this occurs, conventionally, so-called rounding processing for directly bringing back the dynamic range of the image data to an original dynamic range is performed from reasons of an algorithm for image processing and a hardware configuration therefor. Figs. 6 is showing wave changes before spatial filter processing (Fig. 6 (A)) and after spatial filter processing (Fig. 6 (B)) when a horizontal axis is represented by image data continuing in a raster format and a vertical axis is represented by the number of bits. Fig. 6 also shows a state in which a dynamic range (n bits) after the spatial filter processing (Fig. 6 (B)) is larger than a dynamic range (m bits, n>m) before the spatial filter processing (Fig. 6 (A)). If the dynamic range of n bits is directly rounded to m bits, a wave of the image data takes a trapezoidal shape with steep rising edge as indicated by a wave change shown in Fig. 6 (C), that is, non-linear processing is performed, which causes moire.

[0022]

Thus, the spatial filter processing unit 7a calculates a maximum tone value of the image data after the spatial filter processing based on a spatial filter factor set in advance and expands a dynamic range of outputted image data to become larger than the value. In this embodiment, since the dynamic range before the spatial filter processing is eight bits, if the calculated maximum tone value is, for example, 1024, the dynamic range is expanded to a dynamic range of eleven bits. Then, the image data of this dynamic range is passed to the resolution conversion first processing unit 7b.

[0023]

The resolution conversion first processing unit 7b applies conversion processing for a resolution to the image data received from the spatial filter processing unit 7a using a well-known cubic function interpolation or the like.

Fig. 7 is a pixel arrangement diagram for explaining resolution

conversion. The resolution conversion first processing unit 7b generates image data in an order of, for example, G'n-1, Gn, G'n+1, Gn+1 ... from original pixels G (Fig. 7 (A)) received from the spatial filter processing unit 7a and interpolation pixels G' (Fig. 7 (B)) around the original pixels G and obtains an interpolation pixel G'n by applying the cubic function interpolation to the image data.

[0024]

When both Gn and G'n have a resolution of 600 DPI, moire occurs with respect to a halftone dot image in both the cases. However, when it is considered that Gn and G'n are synthesized, there is a resolution of 1200 DPI, which is equivalent to reading the image at a resolution of double density. Thus, almost no moire occurs.

Fig. 8 is a diagram showing wave changes due to resolution conversion at the time when a horizontal axis is represented by image data continuing in a raster format and a vertical axis is represented by the number of bits. After the conversion, a wave before the conversion (Fig. 8 (A)) changes to a wave converted to double density (Fig. 8 (B)).

[0025]

Then, the resolution conversion first processing unit 7b performs rounding for converting the image data converted to the double density into m bits (eight bits) while keeping the dynamic range of n bits (eleven bits). Since the resolution conversion first processing unit 7b performs rounding of the image data with a double density resolution, the wave of the image data changes to a trapezoidal shape with a gentle rising edge as indicated by a wave change shown at the Fig. 8 (C). In other words, since linear processing may be performed, occurrence of moire due to a saturation operation may be surpressed.

[0026]

The image data converted to the double density and rounded to eight bits is passed to a gamma correction processing unit 7c. The gamma correction processing unit 7c applies a well-known gamma correction to the received image data. Since this gamma correction

is also applied to image data with a double density resolution, even if somewhat steep gamma correction is performed, occurrence of moire due to non-linear processing may be suppressed. Next, the image data after the gamma correction is passed to a resolution conversion second processing unit 7d.

[0027]

The resolution conversion second processing unit 7d applies smoothing filter processing to the image data with eight bits and 1200 DPI after to the gamma correction, and performs down-sampling to convert to the image data into 600 DPI, which is the resolution before the spatial filter processing.

[0028]

The image data converted into the resolution before the spatial filter processing is transferred from the external transfer unit 9 to the storeage unit 21 such as a PC.

[0029]

Note that the gamma correction processing unit 7c is set between the resolution conversion first processing unit 7b and the resolution conversion second processing unit 7d. However, the gamma correction processing unit 7c may be set between the resolution conversion second processing unit 7d and the external transfer unit 9 (see Fig. 26).

[0030]

According to the scanner apparatus according to this embodiment, image data read by the scanner apparatus 10 connected to the LAN 40 is subjected to image processing such as spatial filter processing on the scanner apparatus 10 and the image data after the image processing is transferred to the external storage unit such as the PC 20 connected to the LAN 40. Thus, a user may perform image processing without returning to the PC 20 even if the scanner apparatus 10 and the PC 20 are set in places apart from each other. In this case, occurrence of moire based on a saturation operation and the steep gamma correction may be suppressed, and image data with a high image quality may be generated and transferred.

Note that, when steep gamma correction is not necessary, and the gamma correction processing unit 7c is set between the resolution conversion second processing unit 7d and the external transfer unit 9, it is possible to reduce a size of hardware.

[0031]

In addition, the scanner apparatus according to this embodiment includes a format conversion unit 11 between the image processing unit 7 and the external transfer unit 9 of the scanner apparatus described above.

Fig. 10 is a block diagram of a scanner apparatus having a format conversion unit. In Fig. 10, when a user instructs a compression transfer operation for image data from the operation unit 1, the CPU 1 instructs the format conversion unit 11 provided between the image processing unit 7 and the external transfer unit 9 to perform a compression operation. Then, the format conversion unit 11 applies reversible coding to the image data, compresses an amount of the image data to convert the image data into an image format, which may be held, and passes the image data to the external transfer unit 9. A general-purpose image data compression system such as the JPEG may be used for the format conversion of the reversible coding.

Note that, the format conversion unit 11 may be set after of the gamma correction processing unit 7c, which is in between the resolution conversion second processing unit 7d and the external transfer unit 9 (see Fig. 11).

[0032]

In addition, when the user issues the operation instruction, each operation of the scanner unit, the memory control unit 4, 5, the spatial filter processing unit 7a, the resolution conversion first processing unit 7b, the resolution conversion second processing unit 7d, and the gamma correction processing unit 7c are the same as those described in the above-mentioned embodiments and are the same in embodiments to be described below.

[0033]

According to the scanner apparatus according to this embodiment, the image data is converted into a format for performing data compression by a compression system before image data is transferred to an external storage such as a PC. Therefore, a transfer speed to the external storage unit may be increased and a storage capacity of the external storage unit may be reduced while suppressing occurrence of moire. When the general-purpose image data compression system is used, stored image data is easily handled in the external storage, thus usability of image data is improved.

[0034]

Moreover, in the scanner apparatus according to this embodiment, a halftone processing unit 12 is provided between the image processing unit 7 and the external transfer unit 9.

Fig. 12 is a block diagram of a scanner apparatus having a halftone processing unit. In the figure, the halftone processing unit 12 applies halftone processing (tone processing) such as a well-known error diffusion method, dither method, or simple quantization method to multilevel image data having dynamic range of plurality of bits to convert the image data into image data of one bit/two tones without changing a resolution. The conversion processing is performed according to a user's instruction for halftone processing from the operation unit 1, and the processed image data is transferred from the external transfer unit 9 to the external storage unit 21.

[0035]

Note that the halftone processing unit 12 may be set behind the gamma correction processing unit 7c, which is in between the resolution conversion second processing unit 7d and the external transfer unit 9 (see Fig. 13).

[0036]

According to the scanner apparatus according to this embodiment, since the halftone processing (tone processing) is performed before the scanner apparatus transfers image data to the external storage, the halftone processing may be applied to the image data in which

occurrence of moire is suppressed.[0037]

Moreover, the scanner apparatus according to this embodiment includes a two-level tone processing unit 13 between the resolution conversion first processing unit 7b and the resolution conversion second processing unit 7d of the image processing unit 7, and includes the halftone processing unit 12 between the image processing unit 7 and the external transfer unit 9.

Fig. 14 is a block diagram of a scanner apparatus having a tone binarization processing unit and a halftone processing unit. In the figure, the halftone processing unit 12 performs image data conversion of one bit/two tone without changing resolution as described above, and the tone binarization processing unit 13 applies tone binarization with an arbitrary threshold value to the image data, which is after resolution conversion into a high density by the resolution conversion first processing unit 7b. In the tone binarization in this block, the image data is classified into two values (a maximum value and a minimum value) of the dynamic range to be binarized with an arbitrary threshold value within the dynamic range while being kept as multilevel data. When a user issues an operation instruction for this processing from the operation unit 1, the image processing is performed, and the image data after the image processing is transferred from the external transfer unit 9 to the external storeage unit 21.

[0038]

Conventionally, character recognition processing has been difficult for image data obtained after halftone processing for diffusing dots of image data that put importance on improvement of granularity of halftone, such as error diffusion method. Therefore resulting data has not been used as image data which is to be subjected to character recognition afterwards. However, according to the scanner apparatus of to the embodiment, since moire is suppressed in image date even after halftone processing such as error diffusion method, a same character recognition rate as that of a simple quantization method and the like, which is a halftone processing that do not diffuse

dots, may be obtained.

[0039]

[Effects of the Invention]

Effects of claim 1 and 2 of the present invention: a user does not need to return to PC for image processing as the image processing is performed by a scanner apparatus, and convenience is improved. In this case, good quality image data may be generated by suppressing occurrence of moire caused by saturation operation and transmitted to an external apparatus such as printing device.

Effects of claim 3 and 4 of the present invention: faster transfer speed to the external storage unit is achieved while suppressing occurrence of moire. Storage amount of the external storage unit is also reduced.

Effects of claim 5, 6 and 7 of the present invention: occurrence of moire caused by steep gamma correction may be suppressed, and tone processed data of good image quality may be obtained.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a diagram showing connection status of a scanner apparatus, a printer and a personal computer on an electric communication line.

[Fig. 2]

Fig. 2 is an electric block diagram of a scanner unit according to an embodiment of the present invention.

[Fig. 3]

Fig. 3 is a block diagram of main sections of the scanner unit according to the embodiment of the present invention.

[Fig. 4]

Fig. 4 is a diagram explaining correction data generated based on white reference data

[Fig. 5]

Fig. 5 is a block diagram of the main section of the scanner apparatus.

[Fig. 6]

Fig. 6 is a diagram showing a wave change before and after applying spatial filter processing.

[Fig. 7]

Fig. 7 is a pixel arrangement diagram for explaining resolution conversion.

[Fig. 8]

Fig. 8 is a diagram showing a wave change by the resolution conversion.

[Fig. 9]

Fig. 9 is a block diagram of the main section of the scanner apparatus.

[Fig. 10]

Fig. 10 is a block diagram of the main section of the scanner apparatus.

[Fig. 11]

Fig. 11 is a block diagram of the main section of the scanner apparatus.

[Fig. 12]

Fig. 12 is a block diagram of the main section of the scanner apparatus.

[Fig. 13]

Fig. 13 is a block diagram of the main section of the scanner apparatus.

[Fig. 14]

Fig. 14 is a block diagram of the main section of the scanner apparatus.

[Reference Numerals]

1....Interface unit

2....CPU

3....ROM

4....Scanner unit

5....Memory control unit

6....RAM

7....RAM

8....RAM

9....External transfer unit

[Name of Document] Abstract of the Disclosure

[Abstract]

[Objectives of the Invention]

A scanner apparatus having read image data performs image processing such as moire control to the image data, and transfers the image data to a computer, and the like, connected to a network.

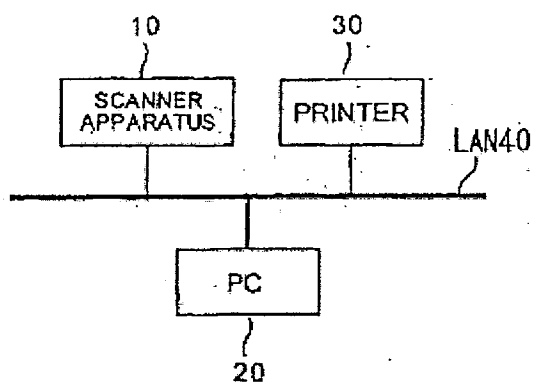
[Means for Achieving the Objectives]

Image data read by a scanner 4 is subjected to filter processing for expanding a dynamic range in a spatial filter processing unit 7a of an image processing unit 7, and to double density conversion of resolution in a resolution conversion first processing unit 7b. The image data converted into double density is subjected to gamma processing in a gamma correction processing unit 7c, and the image data is converted back to resolution at a time of reading of the image in a resolution conversion second processing unit 7d, then transferred to a storage unit 21 such as a computer connected to a network from a external transfer unit 9.

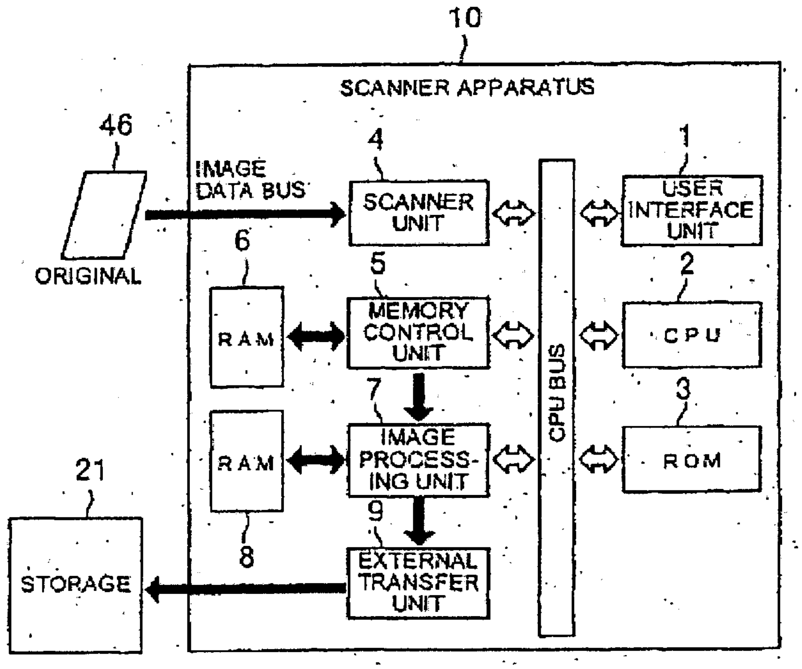
[Selected Drawing] Fig. 5

[Name of Document] Figs

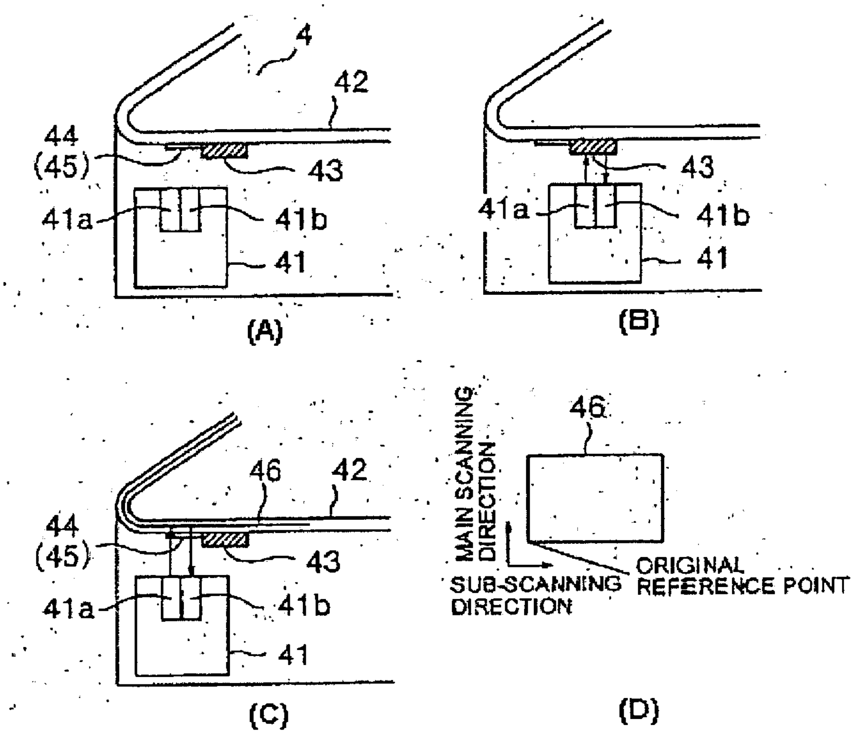
[Fig. 1]



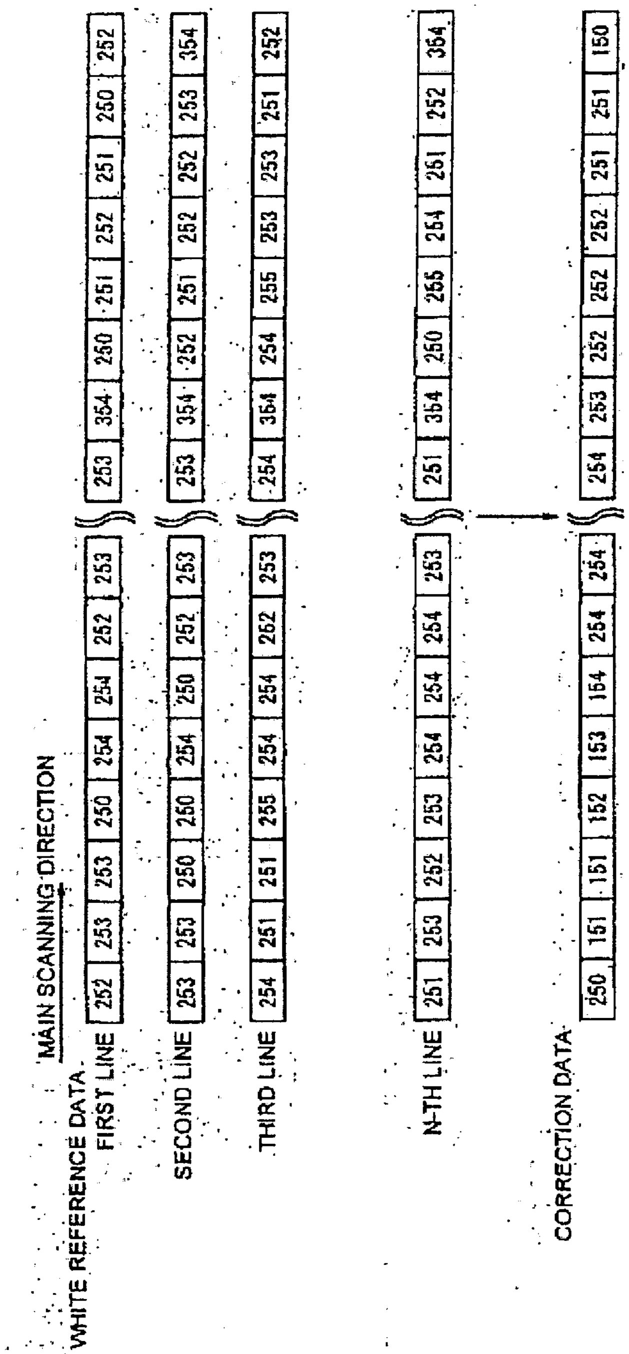
[Fig. 2]



[Fig. 3]

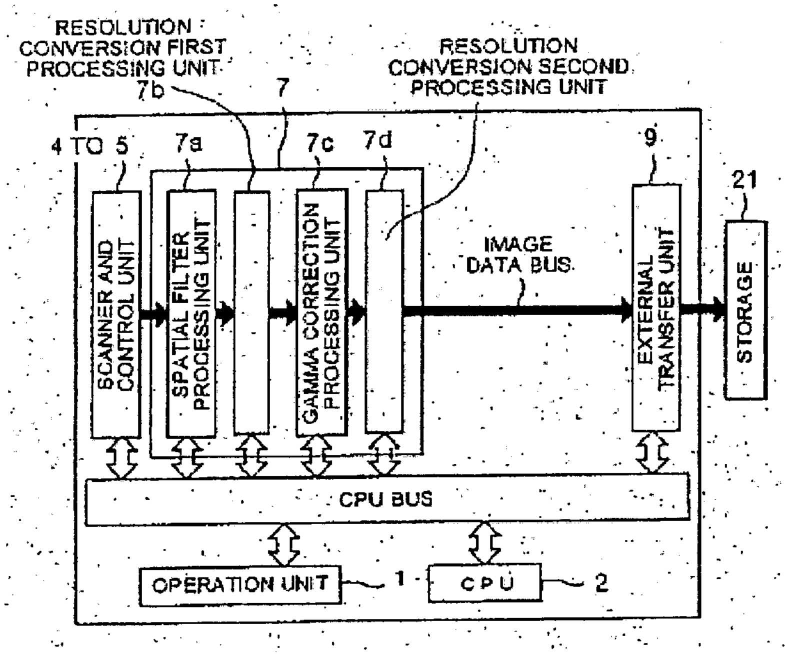


[Fig. 4]



WHITE REFERENCE DATA
MAIN SCANNING DIRECTION
FIRST LINE
252 253 253 250 254 254 252 253
253 354 250 251 252 251 250 252
SECOND LINE
253 253 250 250 254 250 252 253
253 354 252 251 252 252 253 354
THIRD LINE
254 251 251 255 254 254 262 253
254 364 254 255 253 253 251 252
N-TH LINE
251 253 252 253 254 254 254 253
251 354 250 255 254 261 252 354
CORRECTION DATA
250 151 151 152 153 154 254 254
254 253 252 252 252 251 251 150

[Fig. 5]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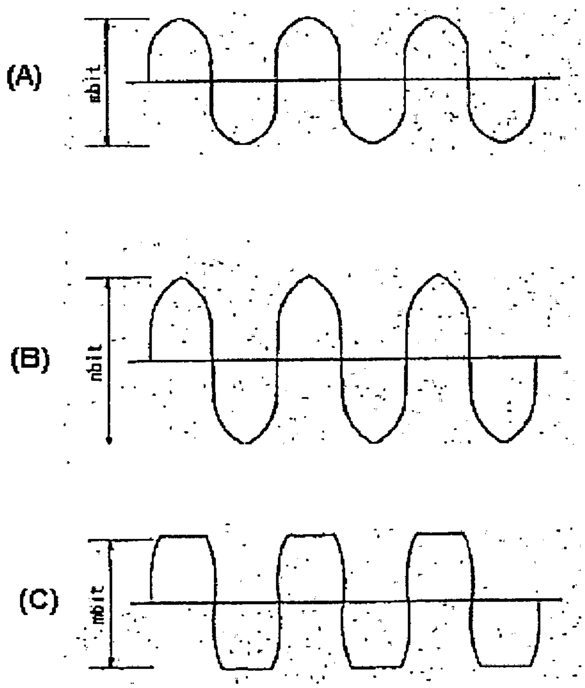
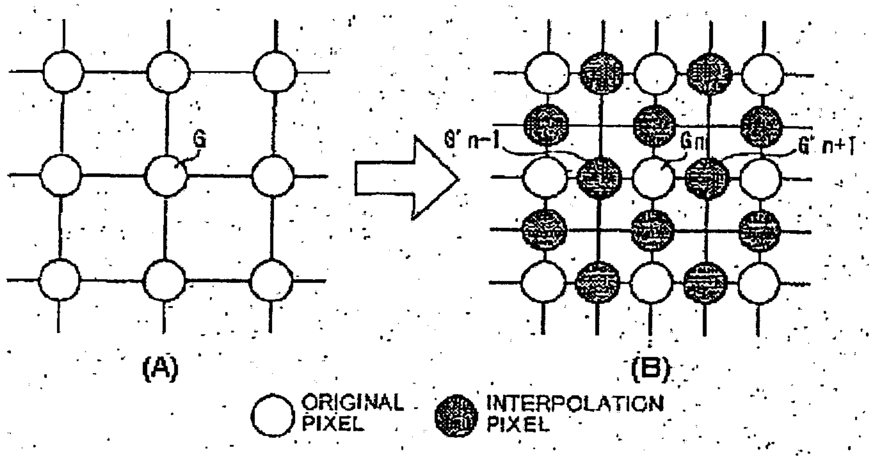
7b
7
RESOLUTION CONVERSION SECOND PROCESSING UNIT
4 TO 5
7a
7c
7d
9
21
SCANNER AND CONTROL UNIT
SPATIAL FILTER PROCESSING UNIT
GAMMA CORRECTION PROCESSING UNIT
IMAGE DATA BUS
EXTERNAL TRANSFER UNIT
STORAGE
CPU BUS
OPERATION UNIT
1
CPU
2

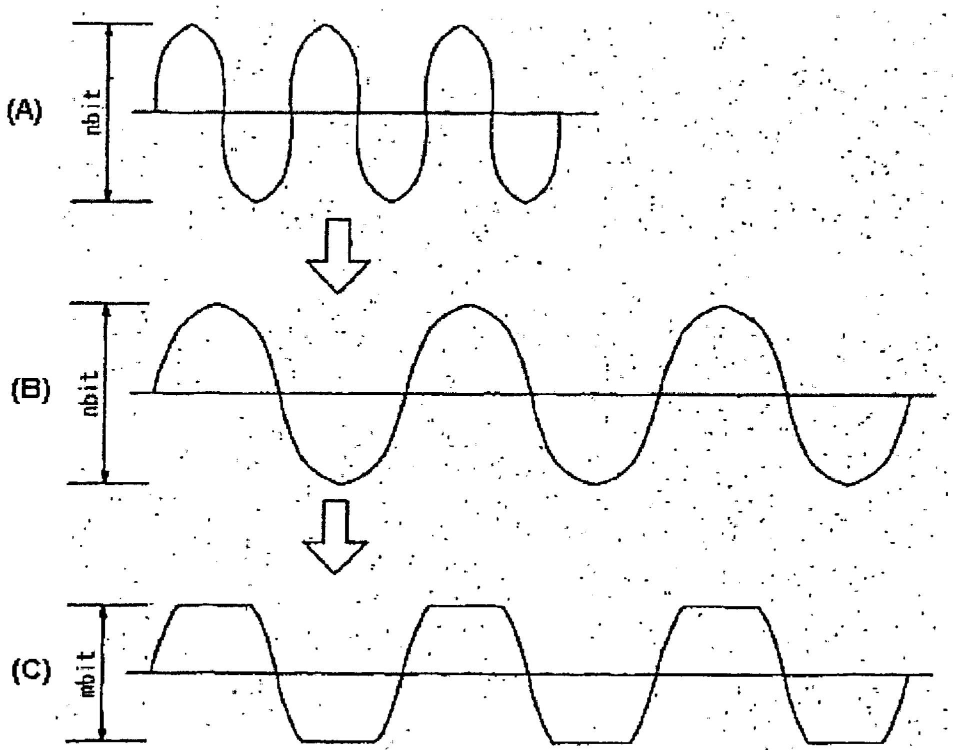
[Fig. 6]


(A)
nbit
(B)
nbit
(C)
nbit

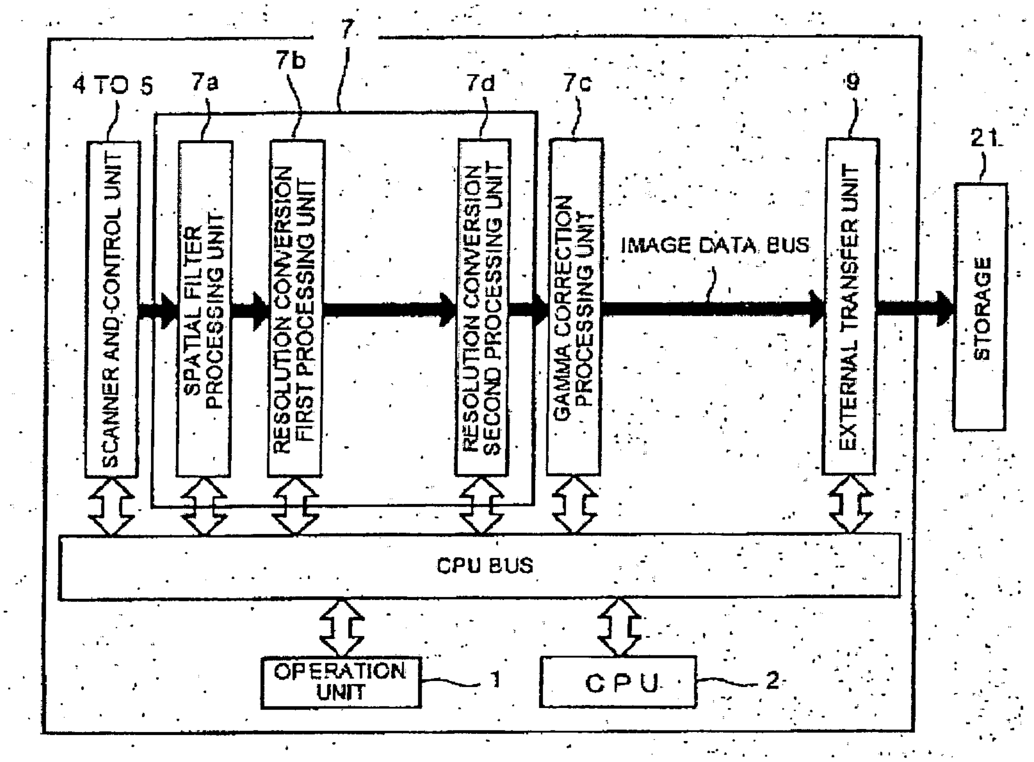
[Fig. 7]


G
G' n-1
Gn
G' n+1
(A)
(B)
ORIGINAL PIXEL
INTERPOLATION PIXEL

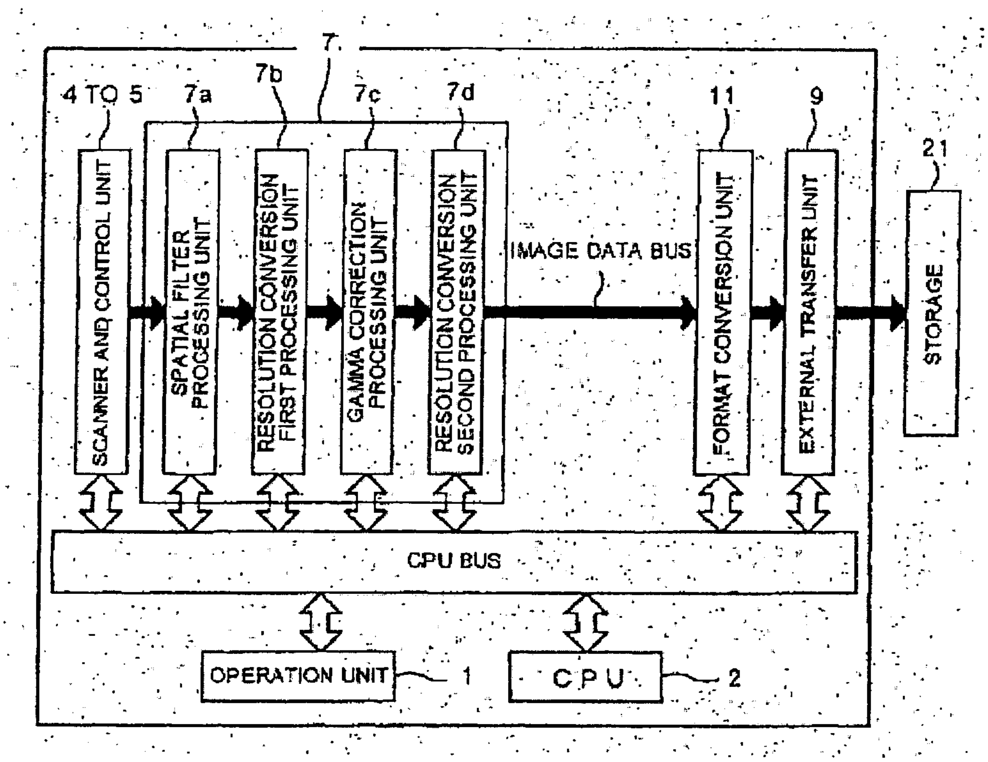
[Fig. 8]


(A)
nbit
(B)
nbit
(C)
mbit

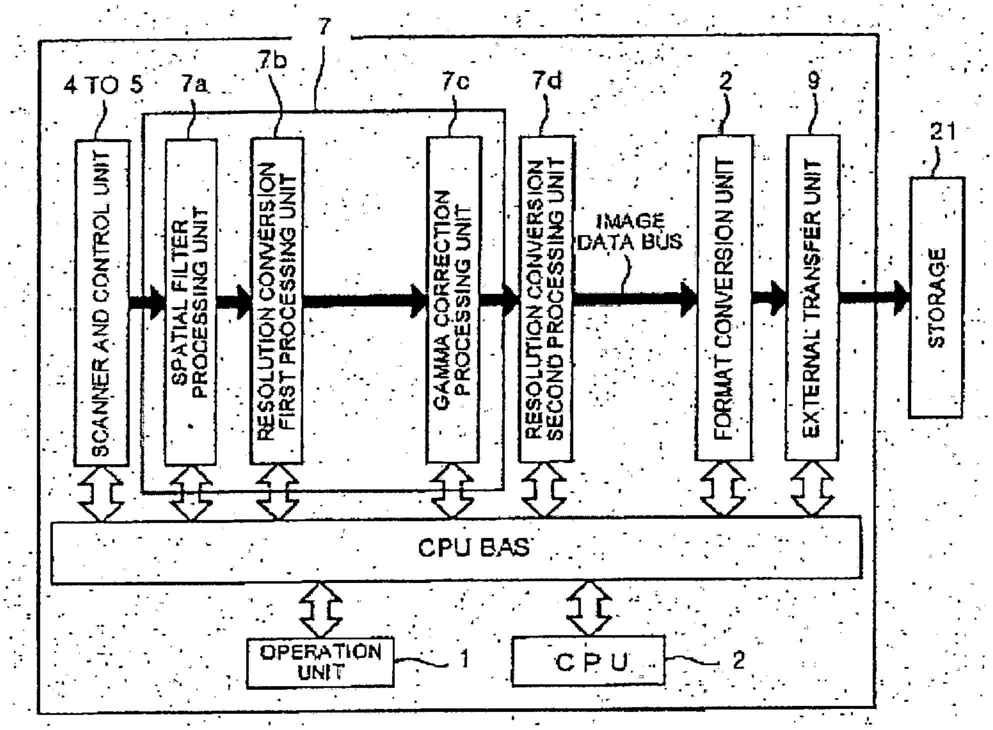
[Fig. 9]


7
7b
4 TO 5
7a
7d
7c
9
21
SCANNER AND CONTROL UNIT
SPATIAL FILTER PROCESSING UNIT
RESOLUTION CONVERSION FIRST PROCESSING UNIT
RESOLUTION CONVERSION SECOND PROCESSING UNIT
GAMMA CORRECTION PROCESSING UNIT
IMAGE DATA BUS
EXTERNAL TRANSFER UNIT
STORAGE
CPU BUS
OPERATION UNIT
1
CPU
2

[Fig. 10]


7
7b
4 TO 5
7a
7c
7d
11
9
21
SCANNER AND CONTROL UNIT
SPATIAL FILTER PROCESSING UNIT
RESOLUTION CONVERSION FIRST PROCESSING UNIT
GAMMA CORRECTION PROCESSING UNIT
RESOLUTION CONVERSION SECOND PROCESSING UNIT
IMAGE DATA BUS
FORMAT CONVERSION UNIT
EXTERNAL TRANSFER UNIT
STORAGE
CPU BUS
OPERATION UNIT
1
CPU
2

[Fig. 11]


7
7b
4 TO 5
7a
7c
7d
2
9
21
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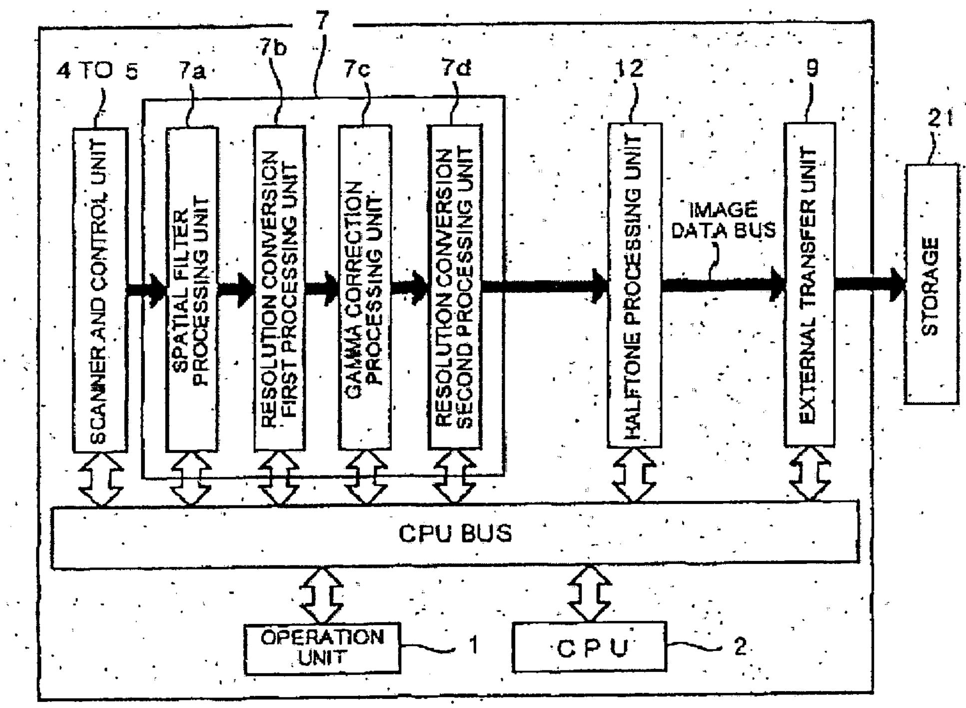
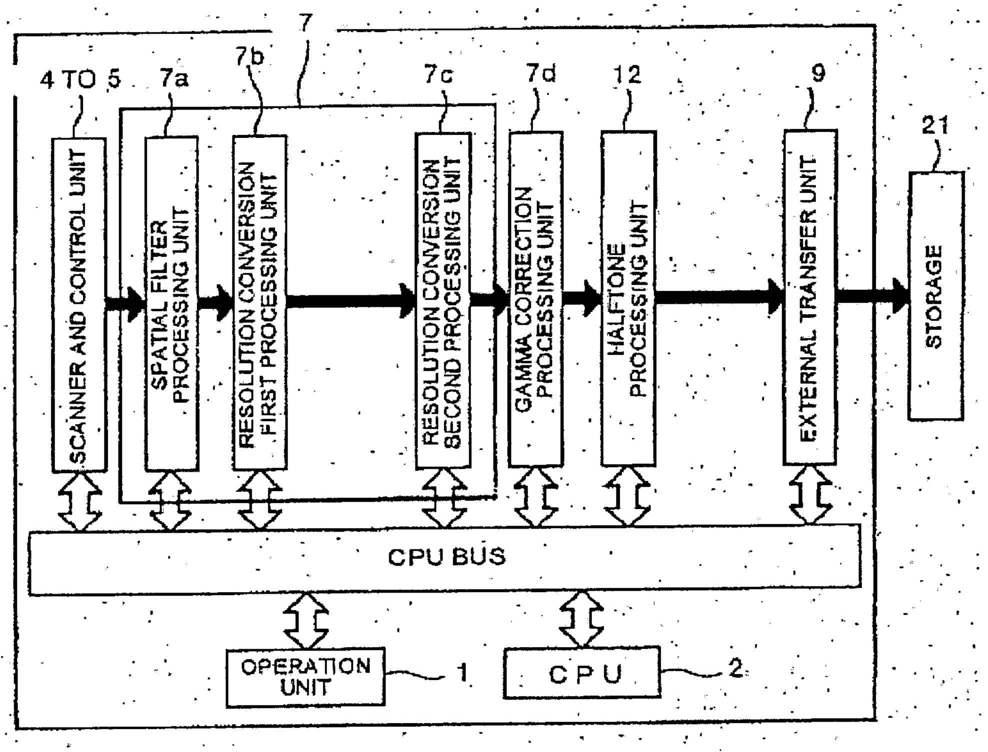
SPATIAL FILTER PROCESSING UNIT
RESOLUTION CONVERSION FIRST PROCESSING UNIT
GAMMA CORRECTION PROCESSING UNIT
RESOLUTION CONVERSION SECOND PROCESSING UNIT
IMAGE DATA BUS
FORMAT CONVERSION UNIT
EXTERNAL TRANSFER UNIT
STORAGE
CPU BAS
OPERATION UNIT
1
CPU
2

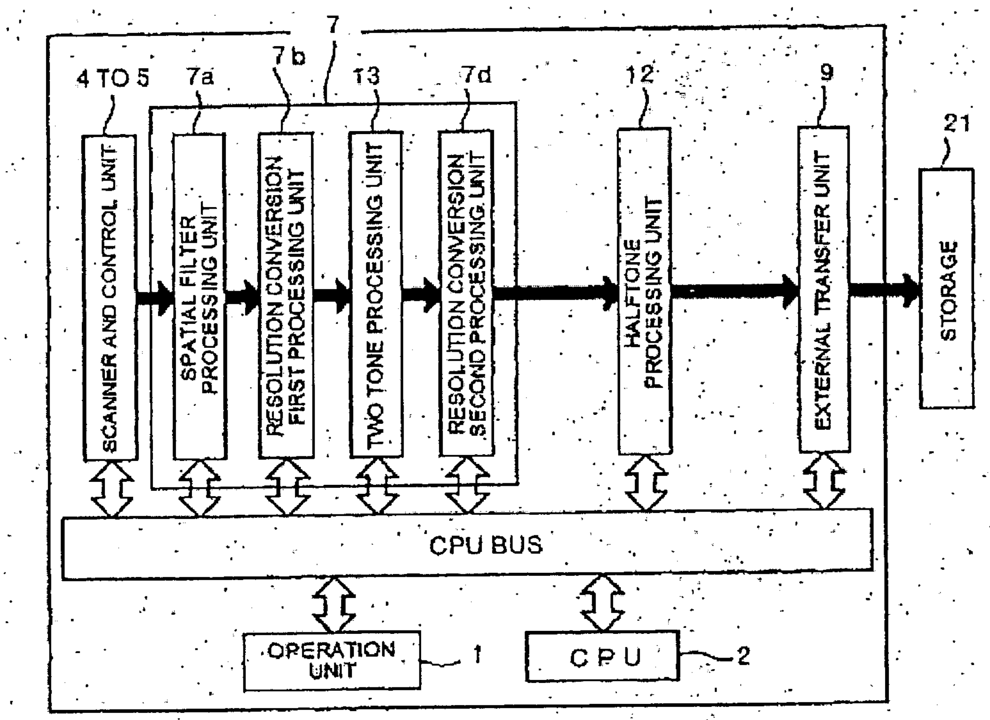
[Fig. 12]


7
7b
4 TO 5
7a
7c
7d
12
9
21
SCANNER AND CONTROL UNIT
SPATIAL FILTER PROCESSING UNIT
RESOLUTION CONVERSION FIRST PROCESSING UNIT
GAMMA CORRECTION PROCESSING UNIT
RESOLUTION CONVERSION SECOND PROCESSING UNIT
HALFTONE PROCESSING UNIT
IMAGE DATA BUS
EXTERNAL TRANSFER UNIT
STORAGE
CPU BUS
OPERATION UNIT
1
CPU
2

[Fig. 13]


7
4 TO 5
7a
7b
7c
7d
12
9
21
SCANNER AND CONTROL UNIT
SPATIAL FILTER PROCESSING UNIT
RESOLUTION CONVERSION FIRST PROCESSING UNIT
RESOLUTION CONVERSION SECOND PROCESSING UNIT
GAMMA CORRECTION PROCESSING UNIT
HALFTONE PROCESSING UNIT
EXTERNAL TRANSFER UNIT
STORAGE
CPU BUS
OPERATION UNIT
1
CPU
2

[Fig. 14]


7
4 TO 5
7a
7b
13
7d
12
9
21
SCANNER AND CONTROL UNIT
SPATIAL FILTER PROCESSING UNIT
RESOLUTION CONVERSION FIRST PROCESSING UNIT
TWO TONE PROCESSING UNIT
RESOLUTION CONVERSION SECOND PROCESSING UNIT
HALFTONE PROCESSING UNIT
EXTERNAL TRANSFER UNIT
STORAGE
CPU BUS
OPERATION UNIT
1
CPU
2